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ABSTRACT

A simple test of ocular dominance in infants is described. In the test, a small point of light is gradually brought closer to the observer along the medial plane. As the light draws closer, in typical cases, one eye will cease to converge, or frequently, it will break from convergence suddenly. The eye which ceases converging or breaks away from convergence is scored as the non-dominant eye. To determine if the test would be applicable to infants, a group of 68 ten-month old were tested. All children converged on the approaching light, and a scoreable uniocular cessation of convergence or sudden divergence were found in all cases. For comparison purposes, 62 nine-year-old children and 86 twenty-five year old adults were tested. Data from these tests appear to indicate that the convergence test does provide a useable index of ocular dominance in infants. (DB)

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The Measurement of Ocular Dominance in Infants

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Dominance of any member of a bilateral pair of organs refers to any sort of physiological preeminance, priority or preferential activity of that organ relative to the other member of the pair. Thus if you consistantly write with your right hand, you have a dominent right hand. If you consistantly kick a ball with your left foot, you have a dominent left foot. In similar terms, if you sight down a telescope consistantly with your right eye you may be displaying a behavior which indicates that you have a dominent right eye.

Although the definition of the behaviours which define a dominent hand or foot is fairly clear, much ambiguity exists about the behaviours which define the dominent eye. Walls (1951) for instance lists some twenty-five tests of ocular dominance, and to this list another dozen or so could easily be added. As if to increase the confusion, there appears to be only a moderate correllation amongst measures of ocular dominance as displayed by Washburn, Faison and Scott (1934), Buxton and Crosland (1937) or Crider (1944). The existance of such apparent inconsistancy is explained by the fact that ocular dominance appears to be composed of three reasonably independent factors. Coren and Kaplan (1973), using a battery of some 13 tests of dominance, isolated these factors which are 1) acuity dominance, 2) sensory dominance, and 3) sighting dominance.

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Acuity dominance is analogous to what ophthalmologists mean by the term ocular dominance. Thus, Duke-Elder (1938) says "When the vision in the two eyes is unequal from some pathological or refractive reason or when strabismus exists, the better eye attains a position of marked supremacy, but when the two are approximately equal in visual acuity there may be little evidence of dominance." Thus, the input from the better eye tends to be used, but this form of dominance seems to restrict conditions where there is a marked difference in ocular efficiency, or where the stimuli are degraded and thus, difficult to apprehend.

Sensory dominance is best seen in the binocular rivalry situation. Here, sustained discrepant inputs are presented to the two eyes. First one and then the other view makes itself available to consciousness. As the views alternate, the view from one eye may be visible for longer periods than the other which would indicate its dominance. Note that this paradigm represents a very unusual stimulus condition not usually found in normal viewing, hence, may not represent a behaviorally important function.

Sighting dominance is the form of dominance most analogous to handedness or footedness. It refers to the eye which is preferred for use in situations where both eyes cannot be used simultaneously. In much the same way that handedness is tested by presenting the subject with a series of tasks in which only one hand can be used at a time, one tests for sighting dominance by forcing a choice of one eye for a given coordination. Thus, the eye which is aligned with the finger when you point at a target, the eye used to peer through a hole, sight down a tube, or sight along a rifle is the dominant eye. Numerous varients of these tests exist, including those of Miles (1929), and Asher (1961) and a number of others reviewed by Coren and Kaplan (1973). With its close resemblence to

handedness, plus the added implicit aspect of choice associated with its measurement, sighting dominance has attracted the most attention from psychologists interested in ocular dominance. In general, most observers show a sighting dominant eye. Crider (1944) finds only 7% mixed dominent, while Miles (1929) finds 5% and Cuff (1930) 9% ambiocular. Of those observers who show ocular dominance, the generally accepted values are 65% right eye dominance and only 35% left eye dominant (cf Duke-Elder 1938).

With the persistent interest in laterality of function and since it is fairly easy to measure, involving simple apparatus and merely enough comprehension on the part of the subject to get him to look into a tube, cone, or apperature, it is not surprising that some investigators have tried measuring the developmental time course of sighting dominance. In all of the developmental tests to date the younger samples have deviated little from the population percentages. Since the tests used require some verbal instruction, very young children have not been tested. For instance, Harris (1957) uses no subjects younger than 7 years and Updegraff (1932) does not report data below 3 years of age. It is not unlikely that the dominent eye would have emerged by these ages, and hence the lack of any measureable developmental changes is not conclusive.

If we are to ascertain the existence of any developmental trends in ocular dominance, it seems important to measure ocular cominance at as young an age as is possible. Since all of the sighting dominance tasks involve verbal instruction, pre-verbal children become a problem. One possible solution is offered by a test of ocular dominance used by Mills (1925, 1928). He was

attempting to ascertain which eye was the motorically dominant eye, using an extention of the ophthalmologists interpretation of the dominant eye as referring to the "better" or "stronger" eye, in terms of motor coordination as well as acuity. The test is actually quite simple. A small point of light is gradually brought closer to observer along the medial plane. In a dim room, the subject usually begins to watch the light, and the convergence of the eyes is clearly seen. As the light draws closer, typically one eye will cease to converge, or frequently, it will suddenly break from convergence (usually associated with a clearly visible divergence). If no failure in the convergence of either eye is observed, the light is held at the terminal position about three inches from the observer on the medial plane) for a few seconds, at which point a break in convergence is usually seen. The eye which ceases converging or breaks away from convergence is scored as the non-dominant eye. Surprizingly, Coren and Kaplan (1973) have noted that this test correlates highly with 5 of the most popular sighting domianace tests with values ranging from 0.42 to 0.52. It loads highly on the sighting dominance factor, and does not correlate significantly with any form of dominance test. The interpretation of this measure as indicating sighting dominance becomes conceptually clearer when one considers that the eye which fails to converge is no longer foveating the target, while the converging eye still maintains it in central vision. This is as clear a choice of sighting, as is viewing through an apperature where one eye is chosen to foveate the target and the other is not. One advantage of this convergence test over other measures of sighting dominance is that it requires no instructions. Preverbal

children readily follow the approaching light, and breaks in convergence are easily seen and scored. This suggests that the proceedure may be useful as a measure of ocular dominance in infants.

In order to determine if the convergence test for sighting dominance would be applicable to infants, a group of 68, ten month old (median age 44 weeks) children were tested. Three trials were administered to each. All children converged on the approaching light (a dim green pen light) and scoreable uniocular cessation of convergence, or sudden divergence were found in all cases. In addition to this population, 62 nine year old children and 86 twenty-five year old adults were tested for comparison purposes. The results appear in table 1.

Insert table 1 about here

If all three responses indicated left eye dominent then the subject is scored in the column marked "left", while if two out of three responses were left dominent it would be scored "mixed left". The same proceedure is used for right eye dominent.

To clarify the pattern of results it is convenient to collapse the table into simply left and right dominent disregarding the consistancy of the responses. This gives us table 2. Here it is clear that all groups show a predominance of right eye dominance (all p 0.05 binomial) and none differ significantly from the expected population proportion of 65% right eye dominent. This may be interpreted as indicating that the adult pattern of ocular dominance has already established itself at the age of 10 months. This is not to say that there are no differences between the age groups in ocular dominance. Table 3 groups the data on the basis

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of consistency regardless of the direction of dominance. Inconsistent means that in the course of the three test trials both left and right responses appear. Now on the basis of chance alone we would only expect 25% of the cases to fall into the consistent category. All groups show more consistency than would be expected on the basis of chance alone ($p < 0.01$ binomial), however the youngest group shows considerably more inconsistent responses than do either of the other two groups ($p < .05$). This data may indicate that the ocular dominance relationship is not as firmly established in infants, or it may simply reflect the typically high variability found in data on pre verbal groups of subjects.

Insert tables 2 & 3 about here

Taken together these data seem to indicate that the convergence test does provide a useable index of ocular dominance in infants. It is a simple test which requires no verbal instructions and very little apparatus (only a pen-type flashlight). In addition the data seem to provide evidence for the existance of a dominant eye in subjects as young as 10 months of age. The pattern of ocular dominance which appears is in accord with the expected population percentages found in adults with a preponderance of right eye dominants although a larger number of response patterns consistent with mixed dominance are found. Thus, we potentially have a means of ascertaining ocular dominance in infants.

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Table 1

Median Age	Left	Mixed Left	Mixed Right	Right	N
10 mo.	17.6	20.6	27.9	33.8	68
9 yr.	24.2	11.3	19.4	45.2	62
25 yr.	18.6	16.3	16.3	48.8	86

Percentage of subjects classified by ocular dominance using a convergence test of dominance.

Table 2

Median Age	Left	Right
10 mo.	38.2	61.8
9 yr.	35.5	64.5
25 yr.	34.9	65.1

Classification by dominant eye, regardless of consistency of response (%).

Table 3

Median Age	Consistent	Inconsistent
10 mo.	51.5	48.5
9 yr.	69.3	30.7
25 yr.	67.4	32.6

Percentage of subjects showing consistent ocular dominance regardless of direction. (On the basis of chance alone one would expect 25% consistency).

Foot Note

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